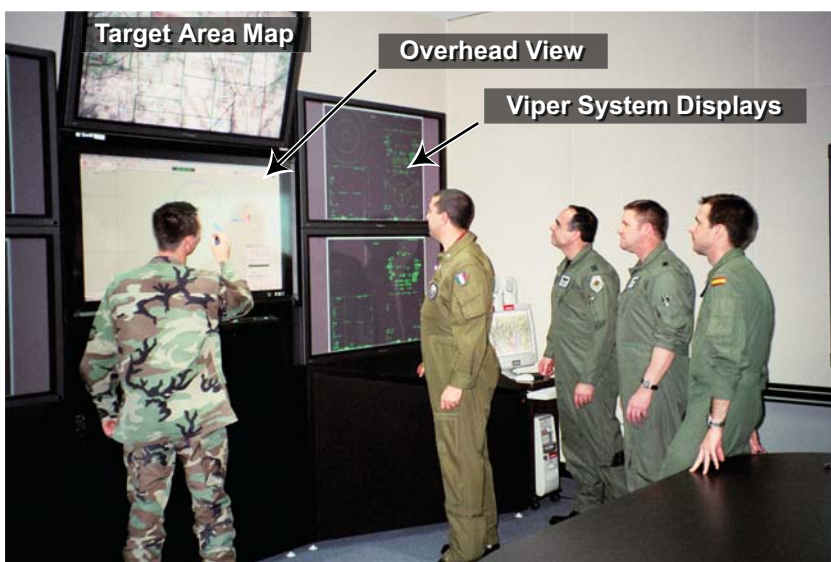


## Training Technologies and Methods Impetus for Distributed Mission Operations

Four combat ready F-16 pilots from the 179<sup>th</sup> Fighter Squadron (FS), Duluth MN Air National Guard (ANG) flew composite force missions from Mesa Research Site's (MRS) Distributed Mission Operations (DMO) Testbed in Virtual Flag (VF) 04-3, a five-day mission rehearsal-level exercise networking more than 300 warfighters from Florida to Alaska. As identified by the Air Force Chief of Staff (CSAF), MRS research and development (R&D) directly feeds critical improvements in training technologies and methods for networked Large-Force Exercises (LFE) encompassing live, virtual, and constructive entities in a DMO environment.

During VF 04-3, the Commander, Air Force Agency for Modeling and Simulation (AFAMS), and a team from the Air Combat Command (ACC) Flight Operations and Training Branch observed missions and monitored radio transmissions amongst the participating warfighters via displays on the DMO Testbed video wall. The ACC team also discussed the potential of DMO systems to support LFE mission rehearsal with 179<sup>th</sup> FS pilots who flew the Viper Multi-Task Trainers (MTT). The pilots noted the photorealistic geo-specific database scenes projected by the Mobile Modular Display for Advanced Research and Training (M2DART) "looked just like Korea." The

AFAMS commander and ACC team garnered additional insights during the out-brief to CSAF via Video Tele-Conference (VTC) prior to VF 04-3 conclusion.



*Capt Ira Schurig illustrates how embedded VTC capabilities enhance interactive digital mission planning, briefing, and debriefing tools for distributed warfighter operations to USAF, Italian, and Spanish aviators assigned to the Allied Command Operations Tactical Leadership Program*

In the continuing DMO evolution, warfighters also employed an upgraded brief/debrief VTC capability, enabling individual warfighters, package, and mission commanders at the various sites to plan, brief, execute, and debrief composite missions featuring the first F-16 Joint Direct Attack Munition delivery in a distributed exercise. Further, the exercise included the Combat Air Force (CAF) Close Air Support Network (CASNET). Front-line A-10 "Hawg" pilots flew Full Mission Trainers (FMT) in Joint Close Air Support (JCAS) scenarios at five linked sites via the low-cost, high training value CASNET architecture.

By rapidly developing the VF 04-3 database, Team Mesa ensured the 179<sup>th</sup> FS pilots flew over easily recognizable photorealistic depictions of the Korean exercise area. Databases supporting high-fidelity simulation require a multitude of engineering and artistic approaches. Image generators (IG) must be capable of maximizing the use of visible and near-visible frequency spectrums, as well as portraying hundreds of square miles of geography. These available spectral bands of overhead imagery, to include visible color photography covering very large geographic areas, enable database engineers (who usually have an artist's flair for detail) to spatially align and merge digitized images into a large area mosaic.



*DMO-capable Joint Terminal Attack Control systems are being developed by Mesa's JCAS program to augment live-ops readiness training, as conducted by this Joint Tactical Air Control Party*

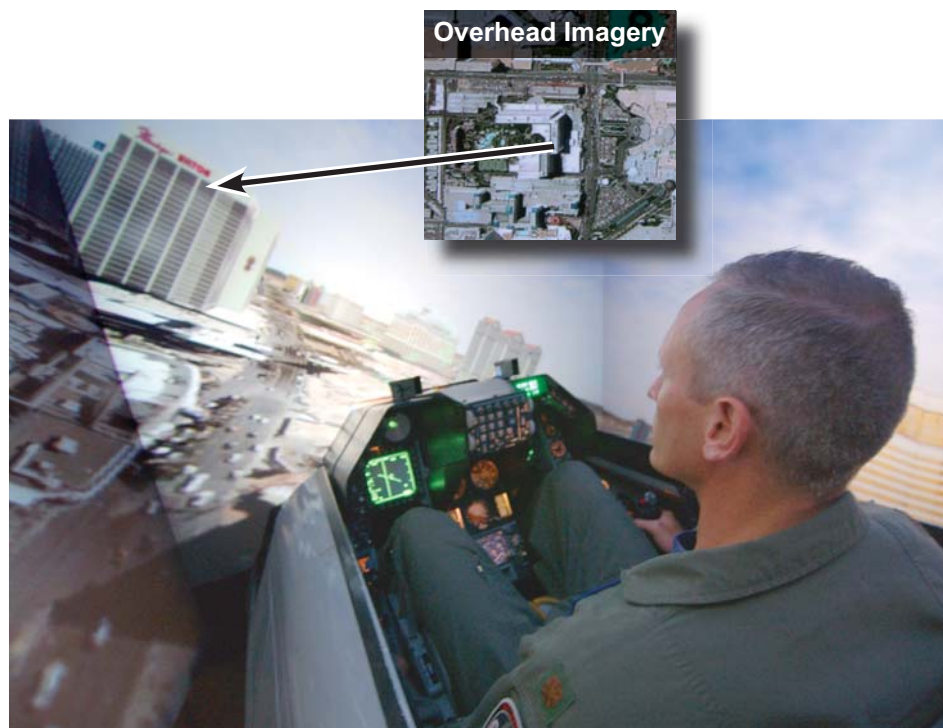
For example, low resolution large area imagery shot from satellites can serve as a “base” layer with embedded overlays of high-fidelity photography specific to critical mission geography where details are vital (home airfields, navigation points, target areas, drop zones, etc). When combined with digital terrain elevation data, three-dimensional (3D) fixed and moving models, and weapons special effects, the mosaic comes to life as an environment capable of emulating dynamic real-world conditions. The melding of low resolution areas and specific high resolution points of interest, including modeled cultural features, supports a wide array of DMO training objectives.

A majority of combat missions are executed at night, and modern databases embed material information based on additional spectral bands to support improved fidelity night vision goggle (NVG) and forward looking infrared (FLIR) simulations such as those being developed by the Division’s Night Operations Center of Excellence. In addition, materials information will improve the accuracy and fidelity of ground mapping depictions such as synthetic aperture radar simulation.

Information available from spectral bands within database mosaics determines materials content of manmade and natural cultural features (asphalt, metal, grasslands, etc.) seen in the imagery. By



*CASNET architecture enables Hawg pilots at widely separated sites to employ multi-ship combat tactics over a range of databases, and conduct emergency and instrument procedures training via remote instructor (and maintenance) capabilities*



*USAF instructor, Maj “Fluids” Bodily, based at NAS Pensacola FL, flies through the hotel “canyons” along Las Vegas Blvd. The high-fidelity database displayed in the M2DART incorporates realistic 3D cultural features modeled from available overhead imagery*

analyzing how cultural features appear to sensors (NVG, FLIR, etc.), database engineers material code individual texture elements (texel) and add 3D models to enhance realism of the synthetic environment. The materials definition process can also refine ground clutter and sensor system “noise” emulation to more accurately represent these real-world phenomena and immerse warfighters in realistic day/night all-weather operations.

Once the spectral and geographic details of a database are rendered to texels, Team Mesa employs IGs capable of eight-channel “out the window” visual displays and two-channel sensor outputs

to the applicable simulator. F-16 pilots in the DMO Testbed fly four-ship air-to-air tactics in the MTTs during training research scenarios, and each Viper pilot is surrounded by a Lab-developed M2DART featuring eight-channel IG displays supporting full 360-degree “out the window” visual immersion. For NVG and other sensor training research, the IG for each Viper MTT has two additional channels, one for NVG simulation and another to replicate complementary systems such as FLIR, targeting pods, or sensor-dependent weapons.



## JCAS Training R&D Enhances Mission Readiness

VF 04-3 scenarios involving “Hawg” FMTs showcased CASNET capabilities and offered unique opportunities to highlight a range of collaborative JCAS training research efforts. Operating from five FMT-equipped sites (Battle Creek MI, Boise ID, Bradley CT, Whiteman AFB MO, and MRS), ANG and Air Force Reserve Command (AFRC) Hawg pilots seamlessly flew JCAS missions under the watchful “eye” of the ANG/AFRC

Distributed Training Operations Center (DTOC) in Des Moines IA. While their individual participation was transparent to other LFE warfighters, the remote operations and maintenance capability of the CASNET architecture enabled distant simulator operators to support each FMT as if they were on-site. As VF unfolded, all FMTs were remotely reloaded, refueled, reset, or given simulated A-10 system malfunctions (i.e., engine failure)



At the end of their DMO Training Research week, two Viper pilots from Cannon AFB NM were the first warfighters to see Mesa's JTAC Virtual Trainer prototype. The program's R&D goals are designed to enhance readiness for JCAS missions

from MRS or DTOC and three CASNET sites were manned only by the pilot flying the FMT (no on-site technicians).

During a follow-on CASNET demonstration featuring Joint Terminal Attack Control (JTAC) training capabilities, Hawk pilots at MRS and Bradley CT struck targets on the Goldwater Range (Arizona) database in a JCAS scenario. A

JTAC controller at the DTOC directed air strikes while both A-10s worked designated targets.

Adding to the CASNET demonstration's realism, the JTAC's visual displays afforded a slewable 90-degree field of view and an overhead view as the A-10s raged on targets with simulated 30mm cannon fire and heavier ordnance. As is the custom prior to departing range space, the JTAC called for a Battle Damage Assessment "door check" and slewed his viewpoint to track each aircraft as it passed overhead his position. With visual contact established, the Hawk pilots obliged with low-level passes directly over the hilltop position where they could see the parked simulated JTAC vehicle.

*Continued on page 4*

## TARGETS OF OPPORTUNITY

✈ Based on the 16th Weapons Squadron (WPS) successfully augmenting the live-fly Weapons Instructor Course (WIC) with a week of intense "4 v X" DMO scenarios over the Nevada Test and Training Range database, the 8th WPS will bring Air Battle Manager (ABM) students of WIC Class 04B to MRS. To support AFRL's ACC-funded DMO training research programs, Viper pilots from Luke AFB AZ and Cannon AFB NM will fly Benchmark scenarios and the MEC-based 5-ride research syllabus developed for F-16 WIC pilots while the 8th WPS controls each mission to augment C2 skill sets of the ABM students. "WIC Weeks" at MRS engender the high "ops tempo" familiar to USAFWS students and instructors, and lessons learned during DMO training research weeks are folded into numerous training research programs to maximize the value of high-fidelity DMO platforms applicable to a variety of CAF weapons systems.



✈ In collaboration with Defence Research & Development Canada (DRDC) - Toronto, and the UK's Defence Science and Technology Laboratory (DSTL), Team Mesa conducted Coali-

tion Mission Training Research (CMTR) engineering trials to develop technologies and procedures for planning, briefing, executing, replaying, and debriefing simulated, composite force air operations while warfighters remain at home stations. Royal Air Force and DSTL representatives observed the trials and met with Team Mesa members to plan future CMTR events at additional sites beyond AFRL, DRDC, and DSTL.



✈ The Division's Space Operations Simulator (SOPsSim) explores intuitive graphical user interface options to accurately depict 6-axis space vehicle movements in response to operator controls. Aircraft operators have the traditional 3-axis environment of pitch, roll, and yaw, but current

space operators must deal with additional degrees of freedom in the positional x, y, and z axes while training without the luxury of real-time visualization of systems. A new SOPsSim software suite applies orbital mechanics calculations, enabling operators to see how the thruster Reaction Control System rockets affect vehicle movement in space. This technology can also be applied to actual space operations, as the operator can see the effect of inputs in real-time before hitting "send" on the control keypad.



Lt Jon Cain, Lt Steve Sharp, and Maj Dave Malinowski prepare to demonstrate the improved SOPsSim software suite. Top screens depict space vehicle movement relative to operator joysticks and keyboard inputs. Bottom screens are "flight instrument" user interfaces to monitor systems and positional data

Continued from page 3

Team Mesa is coordinating efforts to infuse JTAC readiness systems with next-generation DMO capabilities to vastly improve traditional crude communications training methods and rudimentary physical props akin to the no-technology “dark ages.” The team is collaborating on the next phase of the advanced R&D program using feedback and requests from the Air Ground Operations School to update JTAC trainer capabilities at five testbeds, one at MRS and four at Joint sites.

In the broader scope of JCAS training R&D, the Division is surveying 150 of the approximately 700 A-10 pilots in the ANG, AFRC, and active duty inventory to derive insights into Mission Essential Competencies (MEC) required for Combat Mission Ready Hawk drivers. Supported by two research companies, information from the surveys will be applied to MEC work across several USAF, USMC, and US Army JCAS functions essential to coordinated JTAC operations.



*Col Curtis Papke, MRS Commander, led Brig Gen Chuck Ickes from the National Guard Bureau (right), and Col John Mooney (center), AATC Commander, to observe CASNET and Virtual Flag missions during a site visit to discuss DMO readiness training options*

MECs spanning across these JTAC elements will tie readiness requirements and help define the architecture for C2 training systems within a Joint Theater Air-Ground Simulation System (JTAGSS). JTAGSS will include “White Force” nodes to augment LFEs by generating various C2 emulations to ensure interaction with US Army Battalion Tactical Operations Center, US Marine Corps Direct Air Support Center, and

USAF Tactical Control Party, Air Support Operations Center, and Wing Operations Center functions. C2 training research encompasses live, virtual, and constructive warfighter nodes, from the Joint Forces Air Component Commander to the JTAC warfighter, and all points in between.

While exploring numerous JTAC training options, MRS agreed to acquire 12 Distributed Virtual Training Environment (DVTE) simulator systems developed by the USMC’s Training and Education Command. Team Mesa will apply expertise gained from ongoing R&D programs, and incorporate MEC-based scenario training, to assess DVTE potential for the dynamic DMO environment. Team Mesa’s integrated R&D methods are targeted to ensure JTAC and JCAS warfighters are trained to clearly convey indispensable communications under “no-margin-for-error” combat conditions.



## BRIEFS AND DEBRIEFS

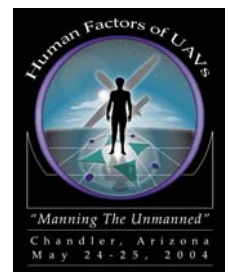
✈ Using the DMO Testbed to support the CF-18 Advanced Distributed Combat Training System (ADCTS) program, nine representatives from the Canadian Air Force’s Strategic (Ottawa), Operational (Winnipeg), and Tactical (Cold Lake) levels participated in an “end-to-end” training exercise, briefings, and technology demonstration. ADCTS team interests included four-ship mission training center concepts, pilot performance assessments, and CMTR opportunities for future coalition DMO training.



✈ In conjunction with the Cognitive Engineering Research Institute, Team Mesa co-hosted a Human Factors of Unmanned Aerial Vehicles (UAV) workshop in Chandler AZ. For the first time, the human factors research community united with UAV developers and the operational community to identify critical human factors challenges. UAVs are becoming increasingly integrated into AF operations, yet there are significant problems with their implementation, especially when it comes to meeting human effectiveness concerns.

For example, in contrast to inhabited aircraft, the *enroute phase* of flight, where 61% of Predator accidents and

75% of Global Hawk accidents occur, is clearly the *most hazardous*. Half of the enroute mishaps are mechanical, but the others have been attributed to human error. Considering UAVs crash at a rate 100 times greater than manned aircraft, human factors issues are an immediate concern relevant to UAV operations and basic research issues in human factors and cognitive engineering. With an eye towards UAV operations, participants identified new cognitive research areas and addressed basic research issues in human factors and cognitive engineering.



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